**RTCA Special Committee 186, Working Group 3**

**ADS-B  1090  MOPS, Revision A**

**Meeting  #14**

**Summary of Changes going into DO-260A**

**Presented by Gary Furr**

| SUMMARY |
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| This is a presentation of all of the changes that have basically gone into DO-260A up to this point in time.  The following table is posted on the ADS-B/1090 web site and is hyperlinked to the files that describe the changes --- in most cases with change bars on the sides |

The changes to DO-260A basically fall into the following categories:

1. Resolution of Open Issues coming out of the RTCA SC-186 Plenary in June 2000

2. Addition of Enhanced Processing Technique requirements and Test Procedures

3. Addition of 1090 Support for Traffic Information Services – Broadcast (TIS-B), which affects additional requirements in section 2.2, test procedures in 2.4, and the restructure of and additions to Appendix A

4. Deletion of the ADS-B Operational Coordination Message

5. Addition of an Appendix N detailing backward compatibility with Version 0

6. Addition of an Appendix O to discuss Trajectory Change Reporting

7. Addition of an Appendix P for reporting of the Performance Results of the Simulations of the LA 2020 Scenario

8. Addition of requirements or modification of requirements in order to accommodate changes made to the ADS-B MASPS (DO-242A)

   a. Change references to $NUC_P$ and $NUC_R$ to become NIC, NIC Supplement, $NIC_{BARO}$, $NAC_P$, $NAC_V$, and SIL

   b. Change of the structure of the Capability Class (CC) and Operational Mode (OM) Codes Subfields

   c. Deletion of all paragraphs dealing with TCP/TCP+1 and replacement with requirements for Target State Reports, Air Referenced Velocity Reports, and the addition of placeholders for Trajectory Change Reports (TCR), as well as the addition of an Appendix O detailing how TCRs could be accommodated in future revisions

   d. The update of all messages and report structures dealing with State Vector, Mode Status and On-Condition Reports

   e. Other minor changes called for in DO-242A, such as deleting the "Turn Indicator"

# Changes proposed and accepted by WG-3 for DO-260A

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| Section 2.2.2.1.1.4 | 7/23/02 | Working Paper WP-12-07 proposed reducing the range of allowed output power level for Class A3 extended Squitter airborne equipment. There were several objections from the manufacturers in WG-3, but after discussion, WG-3 agreed to insert a *Note* into section 2.2.2.1.1.4 indicating that future versions of the MOPS might require a different minimum peak power. |
| Section 2.2.2.2 | 8/27/01 | The reason why DO-260 limited the use of non-transponder devices to class A0 is that the NTD does not use the spectrum as efficiently or provide the system benefits that can be obtained with a transponder implementation of Extended Squitter. A "Note" was proposed to be added to Section 2.2.2.2 based on WP-6-05 to clarify this issue. |
| Section 2.2.3.2.7.1 | 8.27/01 | DO-260 set the TCP Valid Flag to zero (0) in subparagraph 2.2.3.2.7.1.4, indicating that all TCP/TCP+1 data was not valid. A "Note" was proposed in WP-6-01 to be added to subparagraph 2.2.3.2.7.1 explaining the status of TCP/TCP+1 in DO-260A, assuming that no further changes were implemented to TCP/TCP+1 based on proposed changes currently proposed for the ADS-B MASPS, DO-242. |
| Section 2.2.3.2.7.3 Section 2.2.3.2.7.3.5 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message. The purpose of this subfield is to define the Version Number of the formats and protocols in use by the transmitting device. Figure 2-10 in section 2.2.3.2.7.3 was modified to include the Version Number subfield. Also, subparagraph 2.2.3.2.7.3.5 was renamed to define the "Version Number Subfield," and the existing subparagraph 2.2.3.2.7.3.5 was renumbered to become 2.2.3.2.7.3.6. |
| Section 2.2.3.3.2.4 | 2/5/01 | Proposed correction/addition based on WP-2-04, which indicates that a requirement was placed into Appendix A of DO-260 that was not translated into a requirement in Section 2.2 or 2.4. |

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| Section 2.2.3.3.2.6 | 8/27/01 | During Meeting #2 it was agreed that a Version Number would be necessary.  At Meeting #3 in WP-3-01A a Version Number was suggested to be added to the Aircraft Operational Status Message.  During Meeting #6, while discussing other Section 2.2 and 2.4 changes necessary to implement the Version Number, it was agreed that the TCP/TCP+1 Message(s) must be halted during the transmission of the high-speed transmission of the Status Message, and that the transmission rate of the Aircraft Operational Status Message must be increased.  Subparagraph 2.2.3.3.2.6.1 was modified to insert a new subparagraph "c" to indicate that the Aircraft Trajectory Intent Message(s) shall not be transmitted during the high-rate transmission of the Aircraft Operational Status Messages as defined in the modified subparagraph 2.2.3.3.2.6.3.  Subparagraph 2.2.3.3.2.6.3 was modified to eliminate the original subparagraph "a" that restricted initialization of the Aircraft Operational Status Message to situations when there was CC or OM data available.  And, to replace that subparagraph "a" with a new subparagraph that defines a high-rate transmission. |
| Section 2.2.4.3.1.2 | 5/15/02 | Based on work presented in Working Paper WP-11-02, the Working Group agreed during Meeting 11 to make changes to Section 2.2.4.3.1.2 entitled "Re-Triggerable Capability," as described in the Minutes to Meeting 11, Item 6. |
| Section 2.2.4.4 | 7/25/02 | One of the objectives of DO-260A was to provide details of Enhanced Squitter Reception Techniques.  Working Paper WP-12-10, which was the 9th draft of proposed sections 2.2.4.4 and 2.4.4.4 for Enhanced Reception Techniques and their test procedures, was accepted by WG-3 for inclusion into DO-260A. |
| Section 2.2.5.1.44 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message.  Section 2.2.5.1.44 was added to define the Version Number Data. |
| Section 2.2.8.2.17 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message.  Section 2.2.8.2.17 was added with supporting text defining the Version Number in the Mode Status Report as shown in Table 2-70. |
| Section 2.2.8.4 | 11/1/01 | Proposed deletion of Sections 2.2.8.4.1 and 2.2.8.4.2 based on WP-7-09 and the deletion of the Range Monitoring Technique.  This causes previous Section 2.2.8.4.3 to be promoted to become 2.2.8.4, as the sole remaining subparagraph in that section of text. |
| Section 2.2.10.3 | 4/1/01 | Proposed changes identified in WP-2-03 extending the proposed coast time in global decode from 25 to 120 seconds. |

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| Section 2.2.17 | 7/26/02 | Working Paper WP-9-02 was accepted by WG-3 as the 6th draft of TIS-B materials, which WG-3 agreed to place in section 2.2.17.  Working Paper 12-06 was accepted by WG-3 as materials for 2.2.17.4 concerning TIS-B Message Processing and Reporting. |
| Section 2.4.3.2.6.1.12 | 5/15/02 | Working Paper WP-11-11 raised a question received from Industry on the coding of the Vertical Rate and the Geometric Altitude Difference from Barometric Altitude Fields.  After discussion during Meeting 11, the Working Group agreed to change the last line of the last paragraph in Step 3 of Section 2.4.3.2.6.1.12, as documented in the Minutes to Meeting 11, Item 11. |
| Section 2.4.3.2.6.1.15 | 5/15/02 | Working Paper WP-11-11 raised a question received from Industry on the coding of the Vertical Rate and the Geometric Altitude Difference from Barometric Altitude Fields.  After discussion during Meeting 11, the Working Group agreed to change the last line of the last paragraph in Step 3 of Section 2.4.3.2.6.1.15, as documented in the Minutes to Meeting 11, Item 11. |
| Section 2.4.3.2.7.3.3.1 | 2/5/01 | Proposed changes as per WP-2-12, plus open discussion at Meeting #2, Melbourne Florida, as a result of an initial request by Bob Hilb at the June 2000 Plenary which approved DO-260, to add TCAS and CDTI operational status information to the CC_4 subfield of the Aircraft Operational Status Message. |
| Section 2.4.3.2.7.3.5 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message.  Section 2.2.3.2.7.3.5 was modified to define the Version Number and section 2.4.3.2.7.3.5 was modified to provide verification during test procedures. |
| Section 2.4.3.3.2.4 | 4/1/01 | Proposed changes identified in WP-3-10A, plus open discussion at Meeting #3, Phoenix Arizona, as a result of additions made to Section 2.2.3.3.2.4 identified in WP-2-04, which was initially proposed because of a requirement that was placed into Appendix A of DO-260 that was not translated into a requirement in Section 2.2 or 2.4. |

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| Section 2.4.3.3.2.6.1<br>Section 2.4.3.3.2.6.3 | 1/9/02 | With the implementation of the Version Number, it was agreed that the TCP/TCP+1 Message(s) must be halted during the transmission of the high-speed transmission of the Status Message, and that the transmission rate of the Aircraft Operational Status Message must be increased. Subparagraph 2.2.3.3.2.6.1 was modified to insert a new subparagraph "c" to indicate that the Aircraft Trajectory Intent Message(s) shall not be transmitted during the high-rate transmission of the Aircraft Operational Status Messages as defined in the modified subparagraph 2.2.3.3.2.6.3. Subparagraph 2.2.3.3.2.6.3 was modified to eliminate the original subparagraph "a" that restricted initialization of the Aircraft Operational Status Message to situations when there was CC or OM data available. And, to replace that subparagraph "a" with a new subparagraph that defines a high-rate transmission. These test procedures were added to verify the changes made in the respective 2.2 sections. |
| Section 2.4.4.3.1.1.2 | 3/28/02 | During the June 2000 RTCA SC-186 Plenary that approved DO-260, a new paragraph was inserted at Section 2.2.4.3.1.1.c, but there was no associated test procedure drafted to test the added paragraph. This change inserts a new Step 4 into subparagraph 2.4.4.3.1.1.2 and implements further suggestions contained in WP-10-01. |
| Section 2.4.4.4 | 7/25/02 | One of the objectives of DO-260A was to provide details of Enhanced Squitter Reception Techniques. Working Paper WP-12-10, which was the 9th draft of proposed sections 2.2.4.4 and 2.4.4.4 for Enhanced Reception Techniques and their test procedures, was accepted by WG-3 for inclusion into DO-260A. |
| Section 2.4.5.1.44 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message. Section 2.2.5.1.44 was added to define the Version Number Data. Section 2.4.5.1.44 was added to provide verification of the requirement in 2.2.5.1.44. |
| Section.2.4.8.4 | 11/1/01 | Proposed deletions of Sections 2.2.8.4.1 and 2.2.8.4.2 require deletion of corresponding Sections 2.4.8.4.1 and 2.4.8.4.2. This causes previous Section 2.4.8.4.3 to be promoted to become 2.4.8.4, as the sole remaining subparagraph in that section of text and to correspond to the same changes made in Section 2.2.8.4. |
| Section 2.4.10.3 | 4/1/01 | Proposed changes identified in WP-2-03 extending the proposed coast time in global decode from 25 to 120 seconds. |
| Section 3.0 | 7/18/01 | Add a *Note* in Section 3.0 indicating that installation of non-transponder based 1090 MHz ADS-B equipment in airplanes equipped with Mode-S transponders is prohibited, as agreed to by WG-3 in Meeting #5. |

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| Section 3.3.4.5.2 | 7/23/02 | Working Paper WP-12-08 identified a series of typographical errors that have been carried forward from the TCAS MOPS into DO-260 in a formula in section 3.3.4.5.2 wherein the formula for Distance Area Calculations has the "primes" typed in the wrong places and a phrase which had been omitted in the paragraph below the formula. |
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| Figures 2-16abc | 4/1/01 | Proposed changes identified in WP-2-03 and WP-3-13A extending the proposed coast time in global decode from 25 to 120 seconds. |
| Figure A-12 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message. The purpose of this subfield is to define the Version Number of the formats and protocols in use by the transmitting device. Figure A-21 was added in section A.4.11.11 to define the Version Number subfield. Figure A-12 was updated to include the Version Number subfield definition. |
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| Table 2-1 | 8/27/01 | As identified by a reader of DO-260, and documented in WP-6-10, there is no specific statement of requirement for antenna diversity accept in subparagraph 3.3.1. Table 2-1 was modified as per the suggested change in WP-6-10 and discussion during meeting #6, to indicate that A1, A2 and A3 class equipment require antenna diversity and a reference to subparagraph 3.3.1 was placed in a "Note." |
| Tables-2-3+2-4 | 11/1/01 | (1) Proposed changes per WP-4-01 where WG-3 agreed to explicitly state that the Aircraft Operational Status Message should be transmitted by all Class A Aircraft, as well as Class B1 Aircraft. It was additionally agreed that a "Note" would be added to the list of Notes following Tables 2-3 and 2-4, indicating that if the formats for Class B2 and B3 Aircraft changed in the future, then they would be required to transmit the Message containing the Version Number.<br>(2) Proposed changes per WP-6-02 where WG-3 agreed to specify only the MS-P and not distinguish a MS Report for IFR or VFR, and to correct a mistake in the original DO-260 in regards to compliance with DO-242 paragraph 3.4.3.2 and Tables 2-2 and 3-2. |

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| Table 2-5(1+2) Table 2-5(3) | 11/1/01 5/15/02 | (1) Proposed changes per WP-6-03 to define enhanced classes of 1090 MHz ADS-B receivers and to note the limitations of the receivers that do not incorporate the enhanced reception techniques to be outlined in DO-260A, subparagraph 2.2.4.4. (2) Proposed changes per WP-6-02 where WG-3 agreed to specify only MS-P and not distinguish a MS Report for IFR and VFR, and to delete notes related to specifying a deferent SV Report for Class B1. (3) Originating with the changes defined in (1) and (2) above, and based on a Working Group decision to require all A1, A2 and A3 class equipment to support the Enhanced Reception Technique, changes were made during Meeting 11 as identified in the Minutes to Meeting 11, removing the A2E and A3E class designators and defining the remaining A1, A2 and A3 Classes as "Enhanced" only. |
| Table 2-54 | 2/5/01 | Proposed changes as per WP-2-12, plus open discussion at Meeting #2, Melbourne Florida, as a result of an initial request by Bob Hilb at the June 2000 Plenary which approved DO-260, to add TCAS and CDTI operational status information to the CC_4 subfield of the Aircraft Operational Status Message. |
| Table 2-70 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message. Table 2-70 was modified with the addition of the Version Number as Item #17 in the definition of the Mode Status Data Elements, and the adjustment of the number of total bytes of the MS to accommodate the size of the Version Number. |
| Tables 2-89+2-90+2-91 | 2/5/01 | Modified as per WP-2-07, with input from WP-2-05 and open discussion and analysis at Meeting #2, Melbourne Florida, as a result of requests after the production of DO-260 to add columns to the tables expressing the Hexidecimal values of the Angular Weighted Binary Latitude and Longitude values which were already shown in degrees. |
| Table A-13 | 2/5/01 | Proposed changes as per WP-2-12, plus open discussion at Meeting #2, Melbourne Florida, as a result of an initial request by Bob Hilb at the June 2000 Plenary which approved DO-260, to add TCAS and CDTI operational status information to the CC_4 subfield of the Aircraft Operational Status Message. |
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| Appendix A.4.11.11 | 1/9/02 | At Meeting #2 the Working Group agreed to add a Version Number to the Aircraft Operational Status Message. The purpose of this subfield is to define the Version Number of the formats and protocols in use by the transmitting device. Figure A-21 was added in section A.4.11.11 to define the Version Number subfield. |

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| Appendix A.7.8 | 7/17/01 | At Meeting #4 it was agreed by WG-3 that Range-based Decoding should be eliminated from DO-260.  Working Paper WP-5-01 proposed specific text to be changed or eliminated from Appendix A in Sections A.7.8.2 through A.7.8.4. |
| Appendix A – TIS-B stuff | 7/24/02 | At Meeting #10 Working Paper 1090-WP-10-03 was presented, representing draft 6 of a proposed addition of TIS-B materials to Appendix A. The material was accepted by Working Group 3. At previous meetings, it had already been agreed by WG-3 to re-number all of the DO-260 version of Appendix A to A.1.x, and make the TIS-B addition into section A.2. |
| Appendix D1 | 7/22/02 | In WP-9-04, it was proposed to revise Appendix D to include TIS-B Ground Processing.  In order to accomplish this, (a) section D.1 was revised to discuss ATC Surveillance and TIS-B, (b) the numbering of all sections of Appendix D was revised to make the DO-260 version of Appendix D numbered as section D.2, and (c) section D.3 was proposed to cover TIS-B Ground Processing.  WP-12-11 was proposed to revise some of the text in section D.3. |

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| Appendix I6<br><br>Appendix I7<br><br>Appendix I8<br><br>Appendix I9 | 3/15/02<br><br>7/22/02<br><br>7/22/02<br><br>8/28/02 | (1) Modified as per WP-2-09 and WP-2-11, plus open discussion at Meeting #2, Melbourne Florida.  With corrected Figures I-2 and I-3.<br>(2) Modified as per WP-3-05 and WP-3-07 discussed at Meeting #3, Phoenix Arizona.<br>(3) Modified subparagraphs I.3.3.2 and I.4.3.2 as per WP-4-04 and WP-5-02A, to clarify conservative error correction<br>(4) Modified subparagraph I.4.1.2.2.2 as per discussions during Meeting #5 arising from WP-5-08, which discussed conditions for declaring preambles in reference to lead edge positions.<br>(5) Changes identified in WP-6-09 to accommodate enhanced DMTL techniques.<br>(6) Changes identified in WP-9-06 to include an additional enhanced bit and confidence declaration technique editing section I.4.2.3.3<br>(7) Proposed addition identified in WP-10-05 to the end of subparagraph I.4.2.1 to describe the difference in the use of Center Sample and Multi-Sample Techniques.  This paragraph was modified in WP-12-12 to clarify the use of Center Sample with respect to classes of equipment.<br>(8) Changes identified in WP-12-04 to include a diagram in section I.4.3.4, which helps describe the three primary techniques for error detection and correction, showing how they contribute to the total process.<br>(9) Changes identified in WP-13-16R1 that place the "multiple sample technique without table lookup" method for bit and confidence declaration as the first in the discussion of multi-sample techniques, in accordance with Action Item 12-05.  As identified in WP-13-16R1, all changes are in section I.4.2. |
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| **BROAD/SWEEPING CHANGES** | | The following set of identified changes mostly relate to broad and sweeping changes in DO-260 brought about as a result of the changes agreed to by RTCA SC-186 Plenary to produce the revision to the ADS-B MASPS (DO-242A).  In the following changes, it is not always possible to identify individual sections as has been done above. |
| 1090-WP-12-01R2 | 7/30/02 | This Working Paper deals primarily with, but is not limited to, those changes required to DO-260 as a result of changes to Intent Reporting.  DO-260A is expected to accommodate the Trajectory Change (TC) Reports identified in DO-242A.  This Working Paper basically proposes replacing §2.2.3.2.7 and its subsections, and creates §2.2.3.3.1.4 to deal with Broadcast Rates in light of the new requirements. |

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| 1090-WP-12-02R3 | 8/6/02 | This Working Paper deals primarily with, but is not limited to, those changes required to DO-260 as a result of changes to the State Vector, Mode Status and On-Condition Reporting identified in DO-242A. This Working Paper primarily addresses sections 2.2.8.1, 2.2.8.2 and 2.2.8.3 and introduces the Air Referenced Velocity Report and makes changes to 2.2.10 with respect to the required Report changes identified in 2.2.8 subsections. |
| 1090-WP-12-13R2 | 8/8/02 | This Working Paper deals primarily with, but is not limited to those changes required to DO-260 as a result of changing from the NUC Codes to the NIC/NAC/SIL Codes identified as required by DO-242A. It also deals with changes to the Capability Codes (CC) and Operational Mode (OM) Codes in the Aircraft Operational Status Message, which were also revised in DO-242A. |
| 1090-WP-13-04R1 | 8/27/02 | This Working Paper is an examination of 31 Issue Papers that were addressed in Revision A of the ADS-B MASPS (DO-242A), and what corresponding changes are needed in Revision A of the 1090 MHz Extended Squitter MOPS. WG-3 Working Papers and draft MOPS sections that were introduced at meetings of WG-3 prior to Meeting 13 are cited for those Issue Papers whose topics and MASPS changes are already being working on by WG-3 members. The most significant change specifically addressed in this Working Paper is the removal of the "Turn Indicator" and all references to "Turn Rate Date." |